



Puget Sound Georgia Basin Ecosystem Indicator Report

Executive Summary



Marine Water Quality

Conditions Worsening 

The Puget Sound Georgia Basin Ecosystem Indicators give a glimpse into the health of our ecosystem, which includes the interactions among seven million people, their health, local economies and a complex system of water, land, plants, animals and microorganisms. This indicator measures water quality based on seawater density stratification from 1998-2004 in Puget Sound and 1999-2004 in the Georgia Basin. *Seawater density stratification* is an indicator of the degree of mixing within the water column (the water between the surface and the marine floor), its resilience to mixing, and the likelihood that aspects of poor water quality will develop due to human induced pressures. Together, this set of metrics describes the relative vulnerability of marine waters to water quality problems such as excessive algal blooms and low dissolved oxygen levels.

Seawater can be layered, similar to the way an oil and vinegar salad dressing separates. Stratification is a measure of this layering. But unlike salad dressing, water density is affected by temperature and salinity: density increases with *decreasing temperature* or *increasing salinity*. Imagine denser cold and salty water underlying a warmer and fresher surface layer – the bigger the density difference between these two layers, the less likely they are to mix, and water quality problems can develop. Seawater stratification is characterized by its *intensity* and *persistence*. Stratification affects

the overall sensitivity of the water to pollution from humans, such as sewage, excessive use of fertilizers (nutrients) and other chemicals from paved land surfaces, and changes in circulation and the filtering capacity provided by wetlands and vegetated shorelines. In a way, the intensity and persistence of stratification can tip the balance to favor either better or worse marine water quality.

What Is Happening?

The degree of water stratification is labeled in the map at right according to both its intensity and persistence: strong persistent, strong intermittent, moderate infrequent and weak infrequent. In past decades, it appeared as if the marine waters of Puget Sound and the Georgia Basin had an almost limitless ability to assimilate the various wastes from our cities, farms and industries. Recent trends, however, indicate that the natural capacity of these coastal waters to assimilate pollution is much more limited than we thought, particularly in areas such as Hood Canal, south Puget Sound, inner Whidbey basin and the central Georgia Basin. In these areas, as strong stratification has developed and persisted, the respective water quality has steadily decreased. This trend is the basis for the indicator's declining conditions rating. As waters become more stratified, through weather, climate or circulation changes, they become even more limited in their ability to assimilate pollution. Where stratification patterns are strong and relatively persistent, we must do our best to reduce and minimize human impacts on water quality — otherwise, we risk losing these valuable marine ecosystems.



Seawater stratification patterns

Puget Sound

Between 1998 and 2004, a series of 46 stations in greater Puget Sound were monitored monthly for water quality and density stratification. The majority of the stations (23) show moderate infrequent stratification. These are located throughout the Puget Sound and reflect the strong tidal mixing of the area. Eleven stations show strong persistent stratification. These are

typically located near river mouths (e.g. Budd Inlet, Commencement Bay, Port Susan, Possession Sound, Skagit Bay), near river influence (Penn Cove, Saratoga Passage), or where mixing processes are weak (Hood Canal).

continued

What Is Happening? *continued*

Georgia Basin

Between 1999 and 2004, a series of 13 stations, extending from the mouth of Juan de Fuca Strait up to the northern end of the Strait of Georgia were visited seasonally. Each year, surveys were taken in April, June, September and December to capture seasonal variations.

The majority of the stations show strong persistent stratification due to the influence of freshwater from the Fraser River. However, stations located in strong tidally induced mixing areas, such as Boundary Pass, Rosario Strait, and the northern end of the Strait of Georgia, show moderate infrequent stratification.

Why Is It Happening?

Factors that influence stratification include: ambient air temperature, solar radiation, freshwater input from river flows and precipitation, surface winds, internal waves, and tidal circulation. Both freshwater (reducing salinity) and solar radiation (increasing temperature) cause greater density differences to develop between the warmer, fresher surface layer and the cold, salty deep waters.

The role of our geography: The waters at the ends of the deep fjords of the Puget Sound and Georgia Basin, and in the deep bottom waters behind shallow underwater mountains (*sills*), are somewhat isolated from exchange with incoming Pacific Ocean waters. The implications are that pollutants, such as fertilizers or toxics, released into these areas may become entrapped within local areas over relatively long periods of time.

How Does This Affect Me?

When marine water becomes strongly stratified, it becomes more vulnerable or sensitive to human impacts and pollution. These impacts can affect communities and ecosystems in many ways:

- **Low dissolved oxygen impacts:** Strong persistent stratification forms a barrier to mixing and can lead to oxygen declines in the water. In sensitive marine waters, problems associated with low dissolved oxygen levels, or "DO," may become more pronounced and directly affect aquatic life. Low DO levels can kill fish over large areas.
- **Loss of recreation, fishing and wildlife viewing revenues:** This region is very popular for outdoor recreation. Human-caused pollution can quickly contribute to problems in areas with strong persistent stratification. This can include negative effects on the production and diversity of marine life and on the quality of our shorelines and marine waters.
- **Affect the community and ecological legacy we leave to our children and grandchildren.**

What Can I Do?

Your Tool Box

- **Get septic savvy:** maintain your septic system well. Contact Washington State University Cooperative Extension, Marine Advisory Services.
- **Use natural landscaping and low impact development:** See the information on natural lawn care at King County | Yard and Garden Topics and Washington Department of Fish and Wildlife | Landscaping for Wildlife. Check out the Department of Fisheries and Oceans Shorekeepers Program. Read the Puget Sound Action Team *Low Impact Development Technical Guidance Manual for Puget Sound*.
- **Deal with pet waste:** Always carry a plastic bag to pick up after your pet. Pay attention to the "no dog" signs at beaches.
- **Adopt environmentally preferable purchasing programs.**
- **Reduce and control polluted stormwater runoff:** Impervious surfaces and most stormwater systems provide a quick gateway for contaminants to get into local streams, lakes and beaches.

What Are We Doing About It?

Marine water quality responses include: reducing the level of nutrients in our waste discharges, reducing nutrients and other pollution in stormwater runoff, using low impact development approaches and natural landscaping, implementing farm and manure management plans, and using buffers and native vegetation to filter and take-up nutrients that would otherwise become pollution as they reach water bodies.

Learn more http://www.epa.gov/region10/psgb/indicators/marine_wq/

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The Puget Sound Georgia Basin Ecosystem Indicators Report is a collaborative effort brought to you by Federal, State, Provincial and Local partners from the United States and Canada.